

Pacific Halibut Discard Mortality Rates in the 2003 Alaskan Groundfish Fisheries, With Recommendations For Monitoring CDQ Fisheries in 2005

Gregg H. Williams and Din Chen
International Pacific Halibut Commission

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Abstract

Results from analysis of halibut release condition and injury data collected in the 2003 groundfish fisheries, both open access and Community Development Quota fisheries, are presented. Halibut discard mortality rates (DMRs) are shown to vary by year, gear, fishery, and region. Recommendations are provided for 2005 CDQ trawl, longline and pot operations in the Bering Sea/Aleutian Islands region.

Introduction

Pacific halibut discard mortality rates (DMRs) in the Alaskan groundfish fisheries are estimated from viability data collected by National Marine Fisheries Service (NMFS) observers. Analysis by staff of the International Pacific Halibut Commission (IPHC) results in recommendations to the North Pacific Fishery Management Council (NPFMC or Council) for managing halibut bycatch in subsequent seasons. This paper describes the results from an analysis of data collected from the 2003 fishery and includes DMR recommendations the 2005 Community Development Quota (CDQ) fisheries. Recommendations for 2005 open access fisheries were provided in Williams and Chen (2003).

Data Used and Methods

Observer haul-by-haul data from the NMFS NORPAC database were used for this analysis. The data records included the catch of groundfish by species or species group, estimates of the number and weight of halibut bycatch, and the number and length of halibut sampled for release viability or injury by category (excellent/poor/dead for trawl and pot gear, minor/moderate/severe/dead for longline gear). Records for all hauls sampled by observers in 2003 were obtained; hauls not sampled for species composition were excluded.

The first task was to partition the records into target fishery categories. The catch composition for sampled hauls was summed for a reporting week (Sunday through Saturday). The target is then assigned based on the percentage of particular species within the weekly catch composition (Williams 1997).

The targeting determination was based on a series of assumptions about the total catch and retained catch within a reporting week. Midwater pollock hauls were identified and coded if that species comprised 95% of the total catch. A similar approach was used for an arrowtooth flounder target in the Gulf of Alaska (GOA), but the assignment was made at 65% of the total catch. The determination for the remaining targets assumes that all arrowtooth flounder caught in a haul were discarded; the remaining species are assumed retained. Target determination was based on the species/species group comprising the greatest percentage of the “retained” catch.

Flatfish targets in the Bering Sea/Aleutian Islands (BSAI) were determined in a succession of comparisons of individual flatfish species compositions in the catch. Table 1 shows the target codes and definitions used in this analysis.

The approach was modified slightly for CDQ fisheries. Because of the nature of the CDQ operations, vessels can potentially move from one target to another on every haul, rendering a “weekly” approach meaningless. So a target was assigned to each haul, using the same species composition criteria employed for open access fisheries.

NMFS observers examine halibut for the release viability or injury upon return to the sea. Each fish is judged according to a set of criteria (Tables 2-4), which are used to determine internal and external injuries, and body damage from predators (e.g., sand fleas and others). Beginning in 2000, a dichotomous key was provided to reduce subjectivity in the determinations of condition. Observers record the number of excellent, poor and dead condition (trawls and pots) or minor, moderate, severe, and dead (longlines) halibut for each haul/set sampled. Viability samples are only collected on hauls sampled for species composition. The species composition sampling provides an estimate of the total number of halibut caught in the haul, as well as the catch of groundfish, necessary for determining the target. Observers are instructed to limit the number of fish examined to a maximum of 20, although this is occasionally exceeded by enthusiastic observers.

Next, the viability distribution is calculated. First, for each haul, the proportion of halibut in each category is extrapolated up to the total number of halibut caught. The extrapolated numbers of excellent, poor, and dead halibut are then summed within each region/gear/target strata.

The general model for calculating the DMR for halibut caught by gear g is of the form:

$$DMR_g = \sum_{i=1}^4 (m_{i,g} \times P_i)$$

where m is the mortality rate for gear g , and P is the proportion of halibut in condition i , where 1 is excellent/minor, 2 is poor/moderate, 3 is dead/severe, and 4 is dead.

The mortality rate m varies among gear types (see Clark et al. (1992) for trawls, Williams (1996) for pots, and Kaimmer and Trumble (1998) for longlines) and represent the aggregate effects of external and internal injuries to the fish and the presence of predation by amphipods or marine mammals. There can be many sources of injuries, which vary by gear type. For longlines, injuries are most frequently caused by improper release methods used by vessel crews. Other significant factors include the length of the soak time, which can exacerbate the mortality caused by hooking injuries and also increase the potential for amphipod predation. Halibut mortality rates by gear and condition/injury are shown in the following table:

Gear (g)	m_{exc}	m_{poor}	m_{dead}	
Trawl	0.20	0.55	0.90	
Pot	0.00	1.00	1.00	
	m_{minor}	$m_{moderate}$	m_{severe}	m_{dead}
Longlines	0.035	0.363	0.662	1.00

Mean fishery DMRs and associated standard errors have been estimated by assuming that each vessel was a separate sampling unit, enabling a DMR to be calculated for each individual

vessel in a target fishery. The DMR for a target fishery is then estimated as the mean of vessel DMRs, where the vessel's proportion of the total number of bycaught halibut is used as a weighting factor as follows:

Let DMR_v = observed DMR on vessel v
 p_v = proportion of total number of halibut caught on vessel v in a fishery

$$\text{Then } \overline{DMR} = \sum_{v=1}^n (p_v \times DMR_v)$$

Standard errors of the weighted mean DMR were estimated as:

$$V(\overline{DMR}) = \sum_{v=1}^n (p_v^2 \times V(DMR_v))$$

and $SE(\overline{DMR}) = \sqrt{V(\overline{DMR})}$

where $V(DMR_v)$ is the sample variance of all the DMR_s , and $V(\overline{DMR})$ and $SE(\overline{DMR})$ are the variance and standard error of \overline{DMR} , respectively.

Results for 2003 Fisheries

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The number of halibut examined by observers in a single fishery was, in most cases, substantial. For example, observers examined slightly more than 9,000 fish in both the BSAI pelagic pollock and cod trawl fisheries, and more than 16,000 fish in the BSAI cod longline fishery (Table 5). Five of 11 BSAI trawl fisheries had sample sizes greater than 1,000 fish. In contrast, only one out of three longline fisheries (BSAI cod) had more than 1,000 halibut sampled. In the GOA, the trawl fishery for cod had the largest number of halibut examined of any GOA fishery (over 2,500 fish). Shallow water flatfish, arrowtooth flounder and cod longline had 1,200-1,500 halibut examined. All other GOA fisheries had less than 1,000 fish examined; four fisheries had less than 100.

Table 6 reports the viability/injury strata sample sizes and resulting DMRs calculated in the analysis. In general, the DMRs are consistent with results seen in past analyses. Trawl fishery DMRs ranged from 0.50 to 0.90, with DMRs generally higher in the BSAI. Longline fishery DMRs ranged from 0.07 to 0.25. Pot fisheries for cod generally exhibit lower DMRs than longline or trawl, typically less than 0.10. However, the 2003 GOA pot fishery was quite a bit higher (0.21) than is normally seen in this gear type, but not uncommon for the Gulf pot fishery.

Most BSAI trawl fishery DMRs exhibited no significant increase or decrease; results were mixed with no clear trends. For BSAI trawl fisheries, decreases were noted for Atka mackerel (0.85 in 2002 to 0.67 in 2003), bottom trawl pollock (0.78 to 0.65), and turbot (0.75 to 0.67). All others increased or were unchanged.

In the GOA, results were also mixed, as five trawl fisheries declined and four increased. Decreases were seen in bottom trawl pollock, deep water flatfish, arrowtooth flounder, flathead sole, and pelagic pollock, whereas increases occurred in cod, shallow water flatfish, rockfish, and rex sole.

DMRs in the major Pacific cod longline fisheries changed slightly from 2002. The GOA cod fishery DMR increased slightly from 2002, to 0.13. The DMR in the BSAI cod fishery dropped from 0.10 in 2002 to 0.08 in 2003. Since 1996 the BSAI cod fishery has maintained its DMR at 0.11-0.12, and the 2003 value is the lowest seen.

Pot fishery DMRs displayed much different trends in 2002. In the GOA fishery, the DMR increased slightly in 2003, to 0.21. In contrast, the BSAI fishery changed very little from 2002, up slightly to 0.06 in 2003. This low value in the BSAI is more typical of what is expected in pot gear, especially when the pots are turned over frequently and have shorter soak times.

CDQ Fisheries

A summary of observer coverage, sampling, and halibut viability data is shown in Table 9. In 2003, pot, trawl, and longline gear was used in CDQ fishing. Applying the target algorithm on the haul species composition resulted in hauls being identified for all possible targets. However, the majority of data were collected on trawl hauls targeting pollock (pelagic), longline sets targeting cod, and pot hauls for sablefish.

For most trawl targets, almost all halibut were dead when examined, a pattern fairly indicative of pelagic pollock fishing. Only yellowfin sole and bottom trawl pollock showed a DMR lower than 0.90.

Longline CDQ fishing in 2002 consisted primarily of cod fishing. Distribution of halibut injuries in the CDQ longline cod fishery was somewhat poorer to that observed in the open access cod fishery, with a resultant higher DMR (0.20).

Pot effort in 2003 was focused on sablefish. DMRs were significantly higher than what is seen in the open access fisheries for cod. This is likely a reflection of the greater depths of the fishery and the greater inherent mortality potential from those fishery conditions.

Recommendations for Preseason Assumed DMRs for 2004-2006

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In 2000, IPHC proposed, and the Council adopted, a plan to use a long-term average DMR for all open access fisheries for 2001-2003. At the end of that period, new long-term DMRs would be recalculated using the data collected in subsequent years and revisions recommended. In 2000, DMRs for 2001-2003 were recommended, using an average of 1990-1999, which were the most current data available at that time. Williams and Chen (2003) updated this process, with recommendations for 2004-2006, based on data from 1993-2002. Thus, no changes are needed for the open access fisheries at this time.

CDQ Fisheries

CDQ trawl effort in 2003 was focused on pollock, atka mackerel, and yellowfin sole. We calculated the mean DMR for these targets using all available data, and recommend that the 2005 CDQ trawl fisheries be managed using these mean DMRs. The 2005 DMR for bottom trawl pollock is recommended to remain the same as was used in 2004. The remaining targets that occur in 2005 should be managed using the open access 2004-2006 long-term means found in Table 8.

CDQ longline fishing in 2003 was directed primarily at cod and resulted in a DMR of 0.09 (Tables 7 and 9). As with the CDQ trawl fisheries, we calculated a mean DMR for the cod fishery of 0.10 and recommend that this be used in 2005. As with trawls, too few halibut were examined to

provide meaningful results for the other targets. Longline targets other than cod should use the open access long-term mean DMRs shown in Table 8.

The pot fishery DMR for sablefish CDQ fishing was 0.22 in 2003, lower than in past years. Again, the long-term mean DMR was calculated to be 0.33 and we recommend this value be used for 2005 monitoring. Pot fishery targets other than cod that occur in 2005 should use the open access long-term mean DMR until data from those fisheries can be collected and analyzed, and DMRs identified.

CDQ recommendations are summarized in Table 11.

Future Recommendations

IPHC's proposal in 2000 was to manage using long term average DMRs, with revisions on a periodic basis, perhaps every three years or following the implementation of management programs, such as a halibut mortality avoidance program, which would affect DMRs. In following this proposal, our intent is that the recommendations will be used for 2004-2006. Accordingly, we anticipate providing recommendations to the Council in 2006 for the 2007 season.

References

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Table 1. 2003 groundfish target definitions and target determination method used to classify NORPAC hauls in the halibut viability and discard mortality rate analysis.

BSAI		GOA	
Target	Definition	Target	Definition
A	Atka mackerel	A	Atka mackerel
B	Bottom pollock	B	Bottom pollock
C	Pacific cod	C	Pacific cod
F	Other flatfish	D	Deep water flatfish
K	Rockfish	H	Shallow water flatfish
L	Flathead sole	K	Rockfish
O	Other spp.	L	Flathead sole
P	Pelagic pollock	O	Other spp.
R	Rock sole	P	Pelagic pollock
S	Sablefish	S	Sablefish
T	Greenland turbot	W	Arrowtooth flounder
Y	Yellowfin sole	X	Rex sole

OPEN ACCESS and CDQ TARGET DETERMINATION

Bering Sea/Aleutians

- P** if Pollock $\geq 95\%$ of total catch, or
- Y/R/L/F** if (rock sole + other flatfish + yellowfin sole + flathead) is the largest component of the retained catch using this rule:
- Y** if yellowfin sole is $\geq 70\%$ of (rock sole + other flatfish + yellowfin sole + flathead sole), or
- R** if rock sole $>$ other flatfish and rock sole $>$ flathead sole, or
- L** if flathead sole $>$ other flatfish and flathead sole $>$ rock sole, or
- F** if none of the three conditions above are met.

If target is not P, Y, R, L or F, then target is whichever species or species group (A, B, C, K, O, S, T) forms the largest part of the Total Catch.

Gulf of Alaska

- P** if Pollock $\geq 95\%$ of total catch, or
- W** if Arrowtooth flounder $\geq 65\%$ of total catch.

If target is not P or W, then target is whichever species or species group (A, B, C, D, H, K, L, O, S, X) forms the largest part of the Total Catch.

Table 2. Definition of Pacific halibut discard condition codes for trawl gear in 2003.

Excellent: Fish is alive, showing no stress, and injuries, if any, are slight.

1. External injuries.
 - *Superficial nicks or cuts on body.*
 - *Little (<10% of fin area) or no fraying of dorsal and anal fin.*
 - *Hemorrhaging (redness) of skin on white side limited to 5-10% of surface area.*
2. Operculum pressure.
 - *Fish is able to close operculum tightly for at least 5-10 seconds.*
3. Muscle tone and physical activity.
 - *Strong and lively, perhaps flopping around on deck if provoked.*
 - *Fish can tightly clench its jaw.*
4. Bleeding.
 - *No bleeding observed.*
5. Gills and gill color.
 - *Deep red in color.*

Poor: Fish is alive, but showing signs of stress.

1. Injuries are apparent.
 - *Body abrasions have damaged the skin but skin is still present, not missing.*
 - *Cuts and lacerations in body extend through skin just into flesh and are not deep.*
 - *Between 10 and 50% of dorsal and anal fins are frayed.*
 - *Slight bleeding from fin edges.*
 - *Approximately 10-25% of skin on white side of fish shows hemorrhaging.*
2. Operculum pressure.
 - *Fish closes operculum weakly and not sustained.*
3. Muscle tone or physical activity.
 - *Weak, intermittent movement. May respond if stimulated or provoked.*
 - *Body is limp, but not in rigor mortis.*
4. Bleeding.
 - *Blood is continually flowing from gills, but not profusely.*
5. Gills and gill color.
 - *Deep to bright red in color.*

Dead: No sign of life or, if alive, likely to die from severe injuries or suffocation.

1. Injuries are apparent.
 - *Body cavity ripped open.*
 - *Internal organs exposed and damaged.*
 - *Cuts and lacerations in body extend deeply into the flesh.*
 - *Sediment in mouth.*
 - *Hemorrhaging in skin on 25% or more of white side.*
2. Operculum pressure.
 - *Fish does not close operculum.*
3. Muscle tone and physical activity.
 - *No sign of muscle tone (limp) or fish is in rigor (stiff).*
 - *Physical activity absent or limited to fin ripples or twitches.*
 - *Little, if any, response to stimuli.*
 - *Jaw is hanging open.*
4. Bleeding.
 - *Blood is flowing freely and continuously in large quantity from a torn or severed gill arch, or a body injury.*
5. Gills and gill color.
 - *Gills appear washed out, e.g., dull red, pink, or white in color.*

Table 3. Definition of Pacific halibut discard condition codes for hook-and-line gear in 2003.

Minor injuries: Injuries, if any, are slight and inconsequential to health of the fish.

1. Injuries around the mouth from the hook and hook removal are slight.
 - *A hook entrance/exit hole around the jaw or in the cheek.*
 - *The lip (skin covering the external portion of the jaw) may be torn and hanging.*
 - *The hook and some length of residual ganglion may be hanging from the mouth if the ganglion was cut.*
2. Very little bleeding, if any.
 - *Bleeding is seen only in the area surrounding the jaw.*
 - *Bleeding may have stopped, or may be continuing very slowly a few drops at a time.*
3. No penetration of the body or head by sand fleas.
 - *Membranes surrounding eyes and anus are intact, without any holes from sand fleas.*
 - *A few sand fleas may be seen on body and can be wiped off with your hand. Typically, no penetration has occurred when only a few (e.g., <10) sand fleas are found on the body.*

Moderate injuries: Injuries are present, but are not severe.

1. Injuries may have been inflicted to the jaw, cheek, eye, or body.
 - *Lower jaw may be broken into 2 pieces at the snout, but each is still attached at the base of the jaw.*
 - *Jaw is torn on one side or the other, possibly extending through the cheek.*
 - *Hook may have punctured the eye or eye socket.*
 - *Wounds on head and abdomen limited to surface scratches on skin.*
 - *No wounds of any kind to abdominal organs. Abdominal cavity wall not punctured.*
 - *Wounds in body consist of puncture holes in skin, with possibly a flesh tear.*
2. Bleeding is occurring but not from gills.
 - *Blood may be seen around mouth and jaw.*
 - *Blood is not flowing profusely, but is oozing continuously.*
3. No penetration of the body or head by sand fleas.
 - *Membranes surrounding eyes and anus are intact, without any holes from sand fleas.*
 - *A few sand fleas may be seen on body and can be wiped off with your hand. Typically, no penetration has occurred when only a few (e.g., <10) sand fleas are found on the body.*

Severe injuries: Severe life-threatening injuries can be seen.

1. Injuries to the head and/or jaw have occurred. Any of the following will be present, individually or in combination:
 - *Skin on head (forward of preopercle) is ripped and torn deeply, exposing tissue and internal organs.*
 - *Side of the head, possibly including the jaw, has been torn loose and missing from the fish.*
 - *Lower jaw has been torn away and is missing.*
 - *No wounds of any kind to abdominal organs. Abdominal cavity wall not punctured.*
2. No penetration of the body or head by sand fleas.
 - *Membranes surrounding eyes and anus are intact, without any holes from sand fleas.*
 - *A few sand fleas may be seen on body and can be wiped off with your hand. Typically, no penetration has occurred when only a few (e.g., <10) sand fleas are found on the body.*

(cont'd)

Table 3. (cont'd) Definition of Pacific halibut discard injury codes for hook-and-line gear in 2003.

Dead/Fleas/Bleeding: Fish is lifeless, sand flea predation, excessive bleeding

1. Fish is already dead when brought to the surface on the gear
 - *Fish is in rigor and lifeless, even if no apparent injuries.*
 - *Gills appear completely devoid of blood (light pink or white in color).*
2. Marine mammals have taken bites out of the fish
 - *Usually taken out of the back of the fish or from the abdominal cavity.*
3. Sand fleas have penetrated the body via the eyes, fins, or anus.
 - *Membrane surrounding eye may be partially or completely missing.*
 - *Dorsal and/or anal fin membranes may be eaten away, leaving fin rays exposed. Skin on the body is separated from tissue where sand fleas have eaten.*
4. Bleeding is excessive, especially from the gills.
 - *Blood is flowing freely and continuously in large quantity.*
 - *Bleeding is occurring from a torn or severed gill arch.*
5. Internal organs are damaged, possibly by a gaff.
 - *Abdominal cavity wall is punctured or torn.*
 - *Viscera are visible and exposed, and may be protruding.*

Table 4. Definition of Pacific halibut discard condition codes for pot gear in 2003.

Excellent: Fish is alive, showing no stress, and injuries, if any, are slight.

1. External injuries.
 - *Superficial nicks or cuts on body.*
 - *Little (<10% of fin area) or no fraying of dorsal and anal fins.*
 - *Hemorrhaging (redness) of skin on white side limited to 5-10% of surface area.*
2. Operculum pressure.
 - *Fish is able to close operculum tightly for at least 5-10 seconds.*
3. Muscle tone and physical activity.
 - *Strong and lively, perhaps flopping around on deck if stimulated.*
 - *Fish can tightly clench its jaw.*
4. Bleeding.
 - *No bleeding from gills, body, or fins observed.*
5. Gills and gill color.
 - *Deep red in color.*
6. No penetration of the body or head by sand fleas. No predation by crabs.
 - *Membranes surrounding eyes and anus are intact, without any holes from sand fleas.*
 - *A few sand fleas may be seen on body, but can be wiped off with your hand. Typically, no penetration has occurred when only a few (e.g., <10) sand fleas are found on the body.*

Poor: Fish is alive, but displaying physical injuries and signs of stress.

1. External injuries are apparent.
 - *Body abrasions have damaged the skin but skin is still present, not missing.*
 - *Cuts and lacerations in body extend through skin just into flesh and are not deep.*
 - *Between 10 and 50% of dorsal and anal fins are frayed.*
 - *Slight bleeding from fin edges.*
 - *Approximately 10-25% of skin on white side of fish shows hemorrhaging.*
2. Operculum pressure.
 - *Fish closes operculum weakly and not sustained.*
3. Muscle tone or physical activity is weak.
 - *Intermittent body movement. May respond if stimulated.*
 - *Body appears limp, but not in rigor mortis.*
4. Bleeding.
 - *Blood is not flowing profusely, but is oozing continuously from fin edges or body wounds.*
5. Gills and gill color.
 - *Gills are deep to bright red.*
6. No penetration of the body or head by sand fleas. No crab predation.
 - *Membranes surrounding eyes and anus are intact, without any holes from sand fleas.*
 - *A few sand fleas may be seen on body, but can be wiped off with your hand. Typically, no penetration has occurred when only a few (e.g., <10) sand fleas are found on the body.*
 - *No damage to the fish from crabs, if any, in the pot.*

(cont'd)

Table 4. (cont'd) Definition of Pacific halibut discard condition codes for pot gear in 2003.

Dead/Fleas: No sign of life or, if alive, likely to die from injuries or predation.

1. External and internal injuries.
 - *Body cavity may be ripped open.*
 - *Internal organs may be exposed and damaged.*
 - *Body tissue may be torn or ripped in a rough, ragged manner.*
 - *Hemorrhaging in skin on 25% or more of white side.*
2. Operculum pressure.
 - *Fish does not close operculum.*
3. Muscle tone and physical activity.
 - *No sign of muscle tone (limp) or fish is in rigor (stiff)*
 - *Physical activity absent or limited to fin ripples or twitches.*
 - *Little, if any, response to stimuli.*
 - *Jaw may be open and slack.*
4. Bleeding.
 - *Blood is flowing profusely from fin edges or body.*
5. Gills and gill color.
 - *Gills appear washed out, e.g., dull red, pink, or white in color.*
6. Sand fleas have penetrated the body via the eyes, fins, or anus. Crab predation may also occur.
 - *Membrane surrounding eye may be partially or completely eaten by sand fleas.*
 - *Dorsal and/or anal fin membranes may be eaten away, leaving fin rays exposed. Skin on the body is separated from tissue where sand fleas have eaten.*
 - *Crabs in the pot may also have attacked and eaten the "dead" fish.*

Table 5. Information on observer coverage, sampling, and size composition of the halibut bycatch in 2003.

Area/Gear /Target	No. of Vsls Observed	No. of Smpld hauls	No. of fish measured	Mean Length (cm)	Percent <65 cm	Percent < 82 cm
<i>BSAI Longline</i>						
Pacific cod	38	1,072	16,245	66.6	47.3	86.7
Other sp.	8	57	26	78.4	7.7	61.5
Turbot	6	149	113	91.8	12.4	29.2
<i>BSAI Pot</i>						
Pacific cod	54	124	623	63.3	54.3	97.4
<i>BSAI Trawl</i>						
Atka mackerel	17	640	683	58.7	73.4	93.9
Bottom pollock	97	575	3,390	52.6	81.8	94.4
Pacific cod	80	547	9,364	54.4	81.9	94.9
Other flatfish	21	427	997	55.6	73.7	85.0
Rockfish	14	208	79	84.5	22.8	51.9
Flathead sole	12	606	1,130	66.9	48.9	79.2
Other sp.	5	37	283	55.4	83.0	96.1
Pelagic pollock	99	1,312	9,503	56.8	70.9	89.3
Rock sole	20	393	6,359	49.4	85.0	93.6
Turbot	4	55	68	76.5	27.9	66.2
Yellowfin sole	24	765	967	72.1	49.9	65.8
<i>GOA Longline</i>						
Pacific cod	13	286	1,477	70.8	34.1	76.9
<i>GOA Pot</i>						
Pacific cod	19	57	510	70.7	27.3	84.3
<i>GOA Trawl</i>						
Bottom pollock	32	60	451	57.1	74.3	93.3
Pacific cod	50	298	2,528	56.8	74.9	95.5
Dp wtr flatfish	2	24	35	59.3	57.1	85.7
Shall wtr flatfish	19	110	1,205	57.9	68.8	85.9
Rockfish	41	403	753	73.8	31.5	69.6
Flathead sole	8	98	337	64.7	59.6	81.3
Other sp.	2	18	22	80.4	45.5	63.6
Pelagic pollock	40	91	49	63.5	51.0	85.7
Sablefish	2	3	13	67.4	30.8	92.3
Arrowtooth flndr	16	453	1,430	66.8	45.9	89.7
Rex sole	8	284	753	63.5	58.7	90.7

Table 6. Distribution of halibut viability data by condition factor and target fishery during 2003.

Target	Raw Data				Extrapolated Data				
	Exc	Poor	Dead	DMR	Exc	Poor	Dead	DMR	SE
<i>BSAI Trawl</i>									
Atka mackerel	176	47	166	0.541	5,250	2,272	12,073	0.672	0.1176
Bottom pollock	4,115	616	3,149	0.779	17,749	23,931	41,715	0.651	0.0843
Pacific cod	1,834	2,114	3,986	0.645	40,832	47,332	106,947	0.669	0.0378
Other flatfish	65	109	331	0.734	2,355	3,763	19,781	0.786	0.0402
Rockfish	10	20	38	0.694	195	205	2,847	0.836	0.1329
Flathead sole	157	295	481	0.672	4,212	8,201	14,918	0.687	0.1068
Other sp.	1	25	35	0.745	9	984	1,518	0.760	0.0695
Pelagic pollock	12	33	12,307	0.898	15	42	25,636	0.894	0.0113
Rock sole	332	710	5,046	0.821	17,853	44,549	283,866	0.819	0.0428
Turbot	4	21	27	0.705	143	948	814	0.673	0.0625
Yellowfin sole	71	100	702	0.803	2,381	3,073	26,583	0.814	0.0212
<i>BSAI Pot</i>									
Pacific cod	650	20	23	0.062	1,710	50	54	0.057	0.0737
Sablefish	233	103	55	0.404	719	398	161	0.438	0.3526
<i>GOA Trawl</i>									
Bottom pollock	116	109	78	0.506	1,061	802	514	0.470	0.1581
Pacific cod	648	757	1,148	0.619	15,105	17,129	48,247	0.694	0.0513
Deepwater flatfish	29	9	0	0.283	435	200	0	0.310	0.0651
Shallow water flatfish	152	248	855	0.746	2,814	6,413	34,897	0.804	0.1271
Rockfish	162	174	400	0.663	4,476	4,878	9,804	0.647	0.0724
Flathead sole	63	83	36	0.498	1,485	1,364	830	0.488	0.1529
Other sp.	8	5	9	0.566	8	4	6	0.511	-
Pelagic pollock	24	0	29	0.583	112	0	29	0.344	0.4493
Sablefish	0	2	1	0.667	0	91	45	0.667	-
Arrowtooth flounder	236	200	681	0.689	6,135	5,605	18,969	0.696	0.1629
Rex sole	93	325	189	0.605	1,340	4,969	6,457	0.690	0.0798
<i>GOA Pot</i>									
Pacific cod	456	73	55	0.219	1,068	151	134	0.210	0.1123

Target	Raw Data					Extrapolated Data					
	Minor	Mod	Severe	Dead	DMR	Minor	Mod	Severe	Dead	DMR	SE
<i>BSAI Longline</i>											
Pacific cod	15,219	1,278	202	319	0.085	288,648	22,144	3,167	5,826	0.082	0.0169
Rockfish	0	0	0	0	-	0	0	0	0	-	-
Other sp.	34	3	1	0	0.077	567	48	24	0	0.083	0.0372
Turbot	161	20	15	10	0.159	2,461	84	61	30	0.071	0.1404
<i>GOA Longline</i>											
Pacific cod	1,435	245	56	43	0.123	43,501	9,074	1,760	1,490	0.134	0.0287
Other sp.	53	19	5	0	0.157	560	734	74	0	0.245	0.1316

Table 7. Observer coverage and halibut viability/injury data collected from the 2003 Bering Sea/Aleutian CDQ fisheries.

			Raw Data					Ext. data					
	#	# of	Exc./	Poor/	Dead/			Exc./	Poor/	Dead/			
Target	Vessels	Hauls	Minor	Mod.	Sev.	Dead	DMR	Minor	Mod.	Sev.	Dead	DMR	SE
<i>CDQ Longline</i>													
P cod	21	695	2,601	372	59	42	0.100	45,717	5,891	987	634	0.094	0.0172
<i>CDQ Pot</i>													
Sable	4	169	44	6	9	-	0.254	104	12	18	-	0.222	0.1041
<i>CDQ Trawl</i>													
Atka m.	2	179	2	6	82	-	0.861	16	53	614	-	0.857	0.0002
P poll	13	621	1	1	1,687	-	0.899	2	1	4,946	-	0.900	0.0033
Yfin sol	3	265	5	17	382	-	0.877	78	414	15,747	-	0.888	0.0057

Table 8. Summary of halibut discard mortality rates (DMRs) in the Open Access (non-CDQ) Bering Sea/Aleutian Islands (BSAI) groundfish fisheries during 1990-2003. Mean DMR for 1993-2002 used for managing bycatch during 2004-2006.

Gear/Target	'90	'91	'92	'93	'94	'95	'96	'97	'98	'99	'00	'01	'02	'03	DMR Used In 2004-2006¹
<i>BSAI Trawl</i>															
Atka mackerel	66	77	71	69	73	73	83	85	77	81	77	73	85	67	78
Bottom pollock	68	74	78	78	80	73	79	72	80	74	67	74	78	65	76
Pacific cod	68	64	69	67	64	71	70	67	66	69	69	69	69	67	68
Other Flatfish	80	75	76	69	61	68	67	71	78	63	76	81	77	79	71
Rockfish	65	67	69	69	75	68	72	71	56	81	89	85	73	84	74
Flathead sole	-	-	-	-	67	62	66	57	70	79	74	69	60	69	67
Pelagic pollock	85	82	85	85	80	79	83	87	86	87	88	89	90	89	85
Rock sole	64	79	78	76	76	73	74	77	79	81	75	77	83	82	77
Sablefish	46	66	-	26	20	-	-	-	-	90	60	-	-	-	49
Turbot	69	55	-	-	58	75	70	75	86	70	74	68	75	67	72
Yellowfin sole	83	88	83	80	81	77	76	80	82	78	77	74	77	81	78
<i>BSAI Pot</i>															
Pacific cod	12	4	12	4	10	10	7	4	13	9	13	6	5	6	8
<i>BSAI Longline</i>															
Pacific cod	19	23	21	17	15	14	12	11	11	12	12	12	10	8	11
Rockfish	17	55	-	6	23	-	20	4	52	-	12	10	4	-	16
Sablefish	14	32	14	13	38	-	-	-	-	-	-	-	-	-	-
Turbot	15	30	11	10	14	9	15	22	18	17	14	6	23	7	15

¹ Mean DMR for 1993-2002 and adopted by NPFMC at Dec. 2003 meeting.

Table 9. Summary of halibut discard mortality rates (DMRs) in the CDQ Bering Sea/Aleutian Islands (BSAI) groundfish fisheries during 1998-2003.

Gear/Target	'90	'91	'92	'93	'94	'95	'96	'97	'98	'99	'00	'01	'02	'03	Used in 2004	Recommended For 2005
<i>CDQ Trawl</i>																
Atka mackerel	-	-	-	-	-	-	-	-	-	82	89	80	90	86	85	85
Bottom pollock	-	-	-	-	-	-	-	-	90	88	90	90	66	-	85	85
Flathead sole	-	-	-	-	-	-	-	-	-	-	83	90	-	-	67	67 ¹
Pelagic pollock	-	-	-	-	-	-	-	-	90	90	88	89	89	90	89	90
Rockfish	-	-	-	-	-	-	-	-	-	88	-	90	-	-	74	74 ¹
Yellowfin sole	-	-	-	-	-	-	-	-	-	83	-	-	81	89	82	84
<i>CDQ Longline</i>																
Pacific cod	-	-	-	-	-	-	-	-	10	10	13	11	9	9	11	10
Turbot	-	-	-	-	-	-	-	-	-	-	4	-	-	-	7 ¹	15 ¹
<i>CDQ Pot</i>																
Pacific cod	-	-	-	-	-	-	-	-	-	-	7	2	-	-	5	8 ¹
Sablefish	-	-	-	-	-	-	-	-	-	-	38	46	25	22	36	33

Open access fishery DMRs.

Table 10. Summary of halibut discard mortality rates (DMRs) in the Gulf of Alaska (GOA) groundfish fisheries during 1990-2003. Mean DMR for 1993-2002 used for managing bycatch during 2004-2006.

Gear/Target	'90	'91	'92	'93	'94	'95	'96	'97	'98	'99	'00	'01	'02	'03	DMR Used In 2004-2006¹
<i>GOA Trawl</i>															
Atka mackerel	67	89	81	67	53	-	60	-	-	-	-	-	-	-	60
Bottom pollock	51	62	66	57	48	66	79	66	55	55	52	58	55	47	59
Pacific cod	60	62	66	59	53	64	70	62	64	54	57	67	59	69	61
Deep wtr flats	61	58	70	59	60	56	71	61	51	51	62	49	48	31	57
Shallow wtr flats	66	71	69	65	62	70	71	71	67	81	67	62	66	80	68
Rockfish	65	75	79	75	58	71	65	63	68	74	71	61	64	65	67
Flathead sole	-	-	-	-	54	64	67	74	39	51	69	68	74	49	62
Pelagic pollock	71	82	72	63	61	51	81	70	80	86	80	89	90	34	75
Sablefish	70	60	68	59	67	58	80	61	-	68	38	66	62	-	62
Arrowtooth flldr	-	-	-	-	-	-	66	48	62	73	75	86	76	70	69
Rex sole	-	-	-	-	56	76	63	47	58	70	71	62	57	69	62
<i>GOA Pot</i>															
Pacific cod	12	7	16	24	17	21	7	11	16	13	8	33	19	21	17
<i>GOA Longline</i>															
Pacific cod	15	18	13	7	11	13	11	22	11	17	16	11	11	13	13
Rockfish	6	-	-	7	-	4	13	-	9	-	9	-	-	-	8
Sablefish	17	27	28	30	22	-	-	-	-	-	-	-	-	-	--

¹ Mean DMR for 1993-2002 and adopted by NPFMC at Dec. 2003 meeting.

Table 11. Summary of recommended Pacific halibut discard mortality rates (DMRs) for calculating bycatch mortality in the 2005 CDQ groundfish fisheries off Alaska.

	Used in 2004	Recommendation for 2005
<i>CDQ Trawl</i>		
Atka mackerel	85	85
Bottom pollock	85	85
Flathead sole	67	67
Pelagic pollock	89	90
Rockfish	74	74
Yellowfin sole	82	84
<i>CDQ Longline</i>		
Pacific cod	11	10
Turbot	7	15
<i>CDQ Pot</i>		
Pacific cod	5	8
Sablefish	36	33